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# Re-Making Recycling within WPI and the World: An Analysis of the Current Recycling Systems on the WPI Campus

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# Re-Making Recycling

## at Worcester Polytechnic Institute

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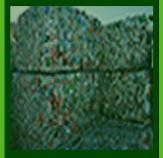
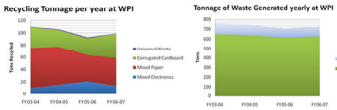


## Current Structure

- The students, employees, and faculty members of the WPI community recycle their bottles, cans, mixed paper, and cardboard in the applicable containers all over campus in various residence halls, administration buildings, and eating areas. It is up to them to not only recycle in the first place, but also to sort their recycling appropriately and not introduce contaminants.
- The two janitorial staff members specifically assigned to recycling cross the campus and collect the recycling with their pick-up trucks. They then deposit the bottle and can recycling in the three large domed containers placed in central locations by the three dining commons, and put the cardboard and mixed paper recycling in separate trash compactors.
- Waste Management hauls the recycling away and the Institutional Recycling Network (IRN), of which WPI is a paying member, decides where the recycling is sold to. By disposing of its recycling through IRN, WPI gets the best mass-quantity prices on its goods, and is assured that its recycling is handled responsibly.
- Annually, WPI produces about 700 to 800 tons of waste, of which 13% is recycled.







## The Need For Change

### Various Issues with the Current Structure

- Although the Sustainability website calls for containers to be "located in the corridor of each residence hall on every floor," in actuality this is not the case. More people would recycle if the convenience of recycling were increased.
- Oftentimes students and other members of WPI's community simply don't recycle for whatever reason. No matter how good a recycling system is, it still relies on human participation.
- Many recyclable goods are not recycled due to lack of education about which items can be recycled. For example, the green-top bins have stickers on that advertise the recycling of aluminum and plastic types one and two only. However, these bins can actually recycle all kinds of plastic in addition to aluminum.
- Disposal of electronic and hazardous wastes is extremely difficult since pick-up dates are poorly publicized.

## Future Objectivs

Our team aims to improve WPI's materials sustainability by:

- generally improving recycling and materials management

AND

- reducing the amount of overall waste created in the first place

THROUGH

- improvement in the arenas of technology, behavior, and system structure

WITH THE FINAL OBJECTIVE OF

- boosting recycling efficiency to 40% of the overall tonnage at WPI, an extremely realistic goal according to the Director of Buildings and Events.

## The Plan

- Technologies (for implementation over both short and long term) can provide solutions to eliminate some forms of waste, reduce others, and improve recycling for still other forms of waste products.
- Behavioral modifications among students and faculty would result in greater use of the systems currently in place, as well as create more social drive for greater sustainability programs in the future.
- Systemic redesign of the internal processing of recycling at WPI makes the processes more efficient, by having directions on locations, bins' accepted materials, and pick-up dates readily available to students and faculty.

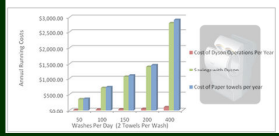
## Technological Solutions

### Short Term

During the research of our first proposed problem, minimizing the influx of used paper towels into the waste stream, we initially considered a means of recycling these waste products. However, when we looked at the practicality of implementing such a solution and the challenges presented in maintaining this idea, we hit upon another philosophy. Instead of merely recycling a significant waste product, why not eliminate the need for its use at all. This realization was what birthed our understanding of eliminating the need for recycling products, by eliminating the creation of waste. These solutions we researched are only a handful out of a bigger pool of available ways to increase sustainability. To determine which solutions are best to implement, a system for comparison must be created, that takes into account sustainability, economic feasability, and functionality.

#### The Dyson Airblade

The Dyson Airblade is a replacement for paper towel usage. It not only eliminates the need to handle the wastes used paper towels create, but does so at a significant reduction of cost as can be see by the chart below.




#### Beverage Refill Machines

This technolgical solution would significantly minimize, if not completely eliminate, the need to recycle aluminum cans and plastic bottles on campus, by refilling beverage containers instead of selling new beverage-filled containers. The solution allows for the beverages to cost less to dispense by the manufacturers, and be priced less, allowing consumers to purchase more of the product they want as well. The technology for automated beverage refilling machines currently exists in other forms, like in the automated coffee dispensing machine (seen to the right), and could easily be adapted to dispense soda and other beverages.

#### Reducing Paper Usage

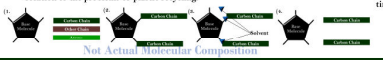
There are many different ways to reduce paper usage here at WPI and at other colleges. Making use of computer based learning makes information constantly available to students and saves on the need for printing paper. Teacher's personal websites and tools such as MyWPI, if incorporated into all classes, can significantly reduce the creation of paper waste; however, when paper does need to be used, conservative printing techniques, such as printing multiple sheets per page can be implemented to minimize the amount of paper used.

### Long Term

While it is ideal to completely eliminate the need for recycling at all, the fact is that there will always need to be some items that are physically used and thus need to be recycled. The most notable of these wastes are those associated with everyday use: metal wastes and plastic wastes. Both of these products pose problems when recycled, currently being downgraded during the recycling process or being more economically feasible to simply throw away than recycled. Because both of these products consist of such a large percentage of our waste, and because there are so many different varieties of these materials around, we need a more effective means to recycle these wastes. No such technologies have yet been invented; however, it does not mean that these technologies have not been conceived. The problem is not if we can implement these technologies but rather a question of when, as either the science needs to catch up to make these solutions affordable and thus practical, or the technology already exists and just needs to be developed. While these solutions for a more sustainable future will not be found directly on the WPI campus, WPI will instead become part of a larger system that makes for a more sustainable society.

#### Designer Polymers

Designing all plastics off of a universal base molecule will allow for a commonality, so that a solvent can be designed to break down any of these polymers, by separating the added atoms and/or chains from the base molecule (as seen below in the diagram). This would allow for a family of polymers designed off of the base molecule to be made to have any of the desired properties, without worrying about compromises needed to make them easily recyclable, as the solvent would be designed to be a substance the plastics would never encounter during usage or in nature. These polymers could then be used to replace all other modernly produced plastics in use. Since the knowledge and understanding in chemistry for this technology has not been developed to the point of easy application, we must place this solution on hold, and consider it as a long term solution to the problems of plastic recycling.




Not Actual Molecular Composition

#### Alloy Sorting

Metal recycling cannot be approached in the same way plastic recycling can, as the chemical structure between metals and alloys varies too much. However, a solution that can be implemented is expanding the techniques used to identify alloys and sort them accordingly. While we proposed two methods for sorting metals: having the wastes be tagged by those recycling the metals before they get shipped off, either by reusable programmable magnetic strips (bottom right) or RFID tags (bottom left); or measuring the metal properties on the spot by performing a dimensional analysis and density calculation of the metal while it goes through a sorting machine or measuring the permittivity of a metal as it goes through the machine. The overall system just needs to be researched and developed, which will take time, making this a long term solution.

## Behavioral Solutions

### Student Involvment

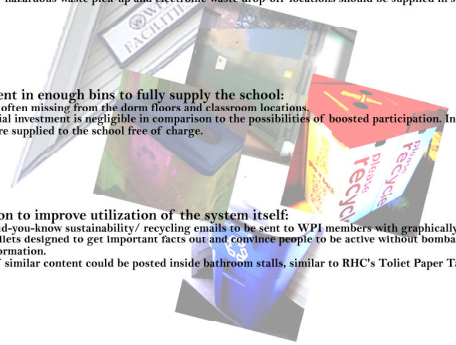
- GAEA (Global Awareness of Environmental Activities), WPI's environmental club.
  - They disseminate information of environmental causes as well as ways to cut waste and energy usage.
  - Involvement in the group would be boosted by greater promotion at the Student Activities Fairas well as by more visible involvement in the community such as competitions throughout the dorms.
  - With more student involvement, GAEA could accomplish more fundraisers, petition for greater waste reduction/recycling measures, and push for greater support from the general student body.
- A "Sustainability Coordinator" would:
  - Greatly improve student participation by getting more upper-classmen involved in their younger peers;
  - Provide education, particularly to the First-Years, and a constant reminder to maintain recycling in and out of the dorms;
  - Be made available to each dorm to educate students on sustainability and WPI's recycling program, just as a Resident Advisor helps students in each dorm adjust to dorm-living and assists their peers in everything from resolving conflicts to picking classes for the next semester;
  - Oversee and/or coordinate such things as competitions, volunteer efforts for collecting recycling, literal "lights out", and other such measures;
  - By having a single person to interact with a group of their peers, the causes of recycling and sustainability take on a face and become more of a personal endeavor for students.

### Raising Awareness

- New Student Orientation programs for First-Years
- First years are the most malleable of all of the classes; they are already adjusting to college experience and the college's outlook on issues such as drinking, safety, drugs, and hazing.
- Including recycling and sustainability would see a greater impact in the number of students willing to make a commitment to recycling.

## Systems Solutions

- Explicit directions provided at each location would make recycling more user-friendly and more effective. Chance of contamination is lessened, improving the quality of the recycled product:
  - Label each bin with accepted materials
  - List common contaminants (pizza boxes, food containers, etc.)
  - Dates of hazardous waste pick-up and electronic waste drop-off locations should be supplied in students' room.
- Investment in enough bins to fully supply the school:
  - Bins are often missing from the dorm floors and classroom locations.
  - The initial investment is negligible in comparison to the possibilities of boosted participation. In the past, bins were supplied to the school free of charge.



- Education to improve utilization of the system itself:
  - Short, did-you-know sustainability/ recycling emails to be sent to WPI members with graphically catching, brief bullets designed to get important facts out and convince people to be active without bombarding them with information.
  - Fliers of similar content could be posted inside bathroom stalls, similar to RHC's Toliet Paper Talk.

## Conclusions

### Continuing into the Future

Our group recognizes the enormity of our undertaking of re-making recycling at Worcester Polytechnic Institute. The recommendations provided above are the product of less than seven weeks of study, analysis, and thought; we understand without a doubt that our analysis and subsequent suggestions can be further modified and improved in many ways.

The results of our study were largely qualitative observations and determinations. With more hard data and numbers, future studies could undertake aspects of this project such as comprehensive cost-benefit analysis of integration of a variety of new technologies on the college campus (i.e. composting).

- A feasibility analysis of using organic and/or local farming for food supply;
- A cost-benefit (economically, environmentally, and socially) analysis of upgrading older buildings on campus to incorporate more sustainable materials technologies;
- The development of a rating system for WPI to prioritize its commitments to sustainable programs and technologies. Those projects which will be most immediately effective and easily implemented should be undertaken first by the school.

### Applying our Findings at Other Universities

- It is important to remember that while this plan may work as a model at WPI, it is not universal. "Think global. Act local," every location and institution has different social, climatological, economic, or ecological atmospheres. The programs that work in Worcester, at the relatively small engineering school of WPI, may not achieve the same effect in California, at the larger and more diverse UCLA. At each new location and in each new setting modifications will be required to achieve maximum potential.
- Likewise, and also in the "think global, act local," frame of mind, WPI should be recognized as a part of a whole. Although the long-term technological solutions presented above are not specific to WPI, the college, working in conjunction with commerce and industry, can affect great change.
- With more time, and the continually refreshing perspectives of new project groups, new projects will continue to yield enormous benefits for WPI, others schools, and the global environment.

Please visit our website at http://users.wpi.edu/~buchenan